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From: Julia Fonseca <Julia.Fonseca@pima.gov>
Sent: Monday, December 08, 2014 8:28 AM
To: 'Douglas, Jason (jason_douglas@fws.gov)'; 'Jeff Simms'; 'blomeli@blm.gov'; 'saleake@usgs.com'; Leidy, Robert
Subject: Empire Gulch and upper Cienega Creek
Attachments: Huth thesis.pdf

Hi, the attached thesis is relevant to the ongoing investigations relating to Empire Gulch and Upper Cienega Creek:

Using historical and new water quality data, the author modeled the chemical evolution of groundwater along the Oak Tree, Empire and Gardner Canyon flow paths to Cienega Creek.

“Spatially, the evidence points to evolution from a calcium-bicarbonate water type at the mountain front to a sodium-bicarbonate type in the central basin....[P]erennial flows likely represent mixing of more than two flowpaths. Not only is the connection between groundwaters and perennial flows supported, but the evolution of source waters from the same mountain front is suggested. This has important management implications since pumping near the mountain front may adversely affect the (source of) baseflow for Cienega Creek.”

“..the high chloride concentration (0.24 mmol/l) in Cienega Creek perennial flows is consistent with chloride content of most shallow well analyses (Appendix 5). This further supports the hypothesis that the shallow aquifer is hydraulically connected to Cienega Creek, and that baseflow has its origin [in] mountain front recharge. It must be emphasized that this conclusion does not exclude a hydrologic connection between Cienega Creek and the deeper aquifer. The lack of a regional confining clay strata suggests that the shallow aquifer is connected to the deeper aquifer. Thus pumping from the latter could affect Cienega Creek baseflow directly.”

I attached portions of the thesis that I copied and scanned. Citation: Huth, Hans. 1996. Hydrogeochemical Modeling of western mountain front recharge, upper Cienega Creek Sub-basin, Pima County, Arizona. MS thesis, University of Arizona Dept. of Hydrology and Water Resources.

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